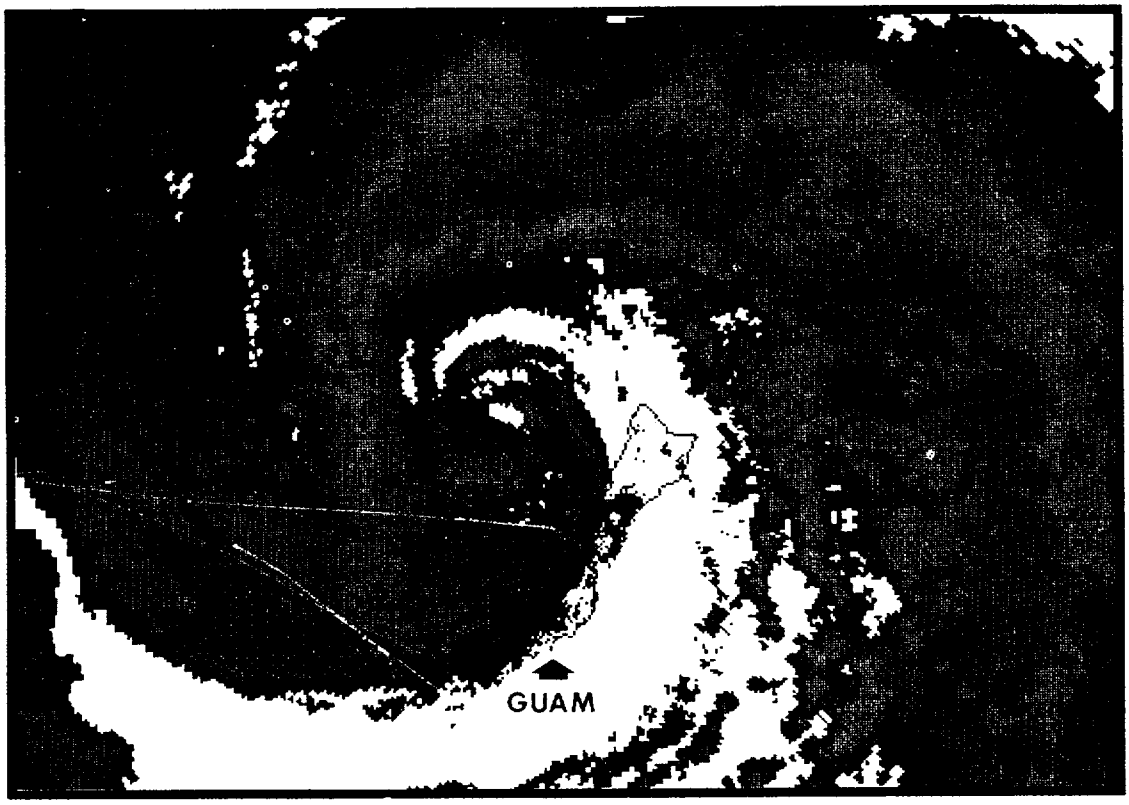
1993
ANNUAL TROPICAL CYCLONE REPORT



JOINT TYPHOON WARNING CENTER
GUAM, MARIANA ISLANDS

Front Cover Caption: As viewed on 301604Z September by the Andersen AFB, Guam Next Generation (Doppler Weather) Radar (NEXRAD), the bands of precipitation associated with Tropical Storm Ed (25W) tightly coil just to the west of the island..

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* TRANSFERRED DURING 1993
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FOREWORD

The Annual Tropical Cyclone Report is prepared by the staff of the Joint Typhoon Warning Center (JTWC), a combined Air Force/Navy organization operating under the command of the Commanding Officer, U.S. Naval Pacific Meteorology and Oceanography Center West (NAVPACMETOCCEN WEST)/Joint Typhoon Warning Center, Guam. The JTWC was founded 1 May 1959 when the U.S. Commander-in-Chief Pacific (USCINCPAC) forces directed that a single tropical cyclone warning center be established for the western North Pacific region. The operations of JTWC are guided by USCINCPAC Instruction 3140.1V.

The mission of JTWC is multifaceted and includes:

1. Continuous monitoring of all tropical weather activity in the Northern and Southern Hemispheres, from 180° east longitude westward to the east coast of Africa, and the prompt issuance of appropriate advisories and alerts when tropical cyclone development is anticipated.

2. Issuance of warnings on all significant tropical cyclones in the above area of responsibility.

3. Determination of requirements for tropical cyclone reconnaissance and assignment of appropriate priorities.

4. Post-storm analysis of significant tropical cyclones occurring within the western North Pacific and North Indian Oceans.

5. Cooperation with the Naval Research Laboratory, Monterey, California on operational evaluation of tropical cyclone models and forecast aids, and the development of new techniques to support operational forecast requirements.

Special thanks to: Captain Donald A. Mautner for his leadership, Lieutenant Colonel (Retired) Charles P. Guard for his outstanding contributions and support to the JTWC over the past four years; the men and women of the Alternate Joint Typhoon Warning Center for standing in for JTWC which was briefly incapacitated after Guam experienced a magnitude 8.2 earthquake; Fleet Numerical Meteorology and Oceanography Center (FLENUMETOCCEN) for their unfaltering operational and software support; the Naval Research Laboratory for its dedicated research and forecast improvement initiatives; the Air Force Global Weather Central for continued satellite support; the 633d Communications Squadron, Defense Meteorological Satellite Program (DMSP) Site 18 at Nimitz Hill, Guam; and the Operations and Equipment Support departments of NAVPACMETOCCEN WEST, Guam for their high quality support; all the men and women of the ships and facilities ashore throughout the JTWC area of responsibility (AOR), and especially on Guam, who took the observations that became the basis for our analyses, forecasts and post analyses; the staff at National Oceanic and Atmospheric Administration (NOAA) National Environmental Satellite, Data, and Information Service (NESDIS) for their tropical cyclone position and intensity estimates; the personnel of Tropical Cyclone Motion-1993 (TCM-93) for sharing their data and understanding of tropical cyclones; the personnel of the Pacific Fleet Audio-Visual Center, Guam for their assistance in the reproduction of satellite imagery for this report; the Navy Publications and Printing Service Branch Office, Guam; Dr. Robert F. Abbey Jr. and the Office of Naval Research for their support to the University of Guam for the JTWC Research Liaisons to JTWC; the University of Guam Research Liaison's for their important contributions to this publication; Dr. Mark Lander for his training efforts, suggestions and valuable insights; and, AG3 Dave Hazel and AGAN Andy Grant for their excellent desktop publishing and graphics.

EXECUTIVE SUMMARY

The 1993 tropical season was a challenging period for the Joint Typhoon Warning Center, Guam (JTWC). Although the North Indian Ocean stayed relatively inactive and the Southern Hemisphere followed climatology; the western North Pacific was very active with 38 tropical cyclones. Overall activity was 15 percent above normal. JTWC issued 1146 warnings distributed over 280 days. Multiple-storm scenarios in our 53 million square mile area were frequent, occurring for 91 days with two or more cyclones and 29 days with three or more. Det 1, 633 Operational Support Squadron and the USPACOM Satellite Reconnaissance Network supported us with more than 4800 fixes. The 67 storms in the JTWC area of responsibility represented nearly 80 percent of the world's tropical cyclones.

The season highlights included Ed and Flo's Fujiwhara confrontation for dominance, Yancy striking southern Japan as a thirty-year typhoon, the preponderance of late season storms bringing a record 20 systems to the Philippines, the multiple-centered 1100 nautical mile circulation of Hattie, and the Next Generation Doppler Weather Radar's (NEXRAD) introduction to tropical meteorology.

Depicted on the cover graphic is Tropical Storm Ed seen from the Guam NEXRAD. The highlight of the season for our local community was that Guam enjoyed a respite from the five typhoons of 1992, recording only a single gust of 53 knots.

The JTWC track forecast errors for the western North Pacific were 112, 213, and 325 nautical miles at the 24, 48, and 72-hour points. This amounts to four, six, and seven percent improvements on the fifteen-year averages. The climatology-persistence model, CLIPER, trailed JTWC by 15 percent with errors of 129, 245, and 368 nautical miles. Forecast intensity errors were also better than historical averages with 10.7, 17.4, and 22.9 knots compared to 12.5, 19.1, and 23.5. Track forecast errors for the North Indian Ocean and Southern Hemisphere were also good. The two "well-behaved" storms in the Northern I.O. resulted in errors of 125, 198, and 231 nautical miles representing four, ten, and 30 percent improvements. Forecast errors on the 27 Southern Hemisphere cyclones were the lowest in JTWC's 12-year history of forecasting in the region at 102 and 199 nautical miles for the 24 and 48-hour forecast points.

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